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THE KODAIKANAL SOLAR PHYSICS OBSERVATORY
IN INDIA.

By C. MICHEL SMITH, Government Astronomer and Director.

Professor HOLDEN having asked me to give some account of the new observatory about to be built in South India, I gladly accede to his request. I must, however, explain at the outset that the plans are still in a somewhat sketchy state, and that the financial difficulties of the Indian Government render it necessary that the work should be commenced on a very modest scale.

The site chosen for the new observatory is near Kodaikanal, a popular Hill Station in the Palani Hills, in the Madura District of the Madras Presidency. The approximate geographical position is Lat. $10^{\circ} 14'$ N., Long. $5^{\text{h}} 10^{\text{m}}$ E.; height above sea-level, 7700 feet. A piece of land measuring about 89 acres has been set apart for the observatory; so that, even if the buildings in the station should extend much more than is at all probable, there is no risk of any houses being so placed as to interfere with the work of the observatory in any way. The hill selected for the observatory itself, though not the highest of the Palanis, is higher than any other near it, and a practically uninterrupted view of the horizon is got in all directions. In selecting the site special attention was paid to the question of mist, since in all such stations there is always a tendency to the formation of dense clouds of mist when the hot moist air rises from the plains. In the east of Kodaikanal the hills drop very rapidly to the plains, and at certain seasons of the year heavy clouds of mist roll up every afternoon; but the site of the observatory lies some two or three miles west of these cliffs, and, so far as I have been able to ascertain, the mist bank seldom reaches so far. I have spent many hours on the hilltop when the mist could be seen covering the whole station to the east, while only an occasional thin wisp drifted over where I was. Misty days and nights will doubtless be experienced at certain seasons, but, so far as statistics are available, the proportion of clear days and nights will be very large.

As regards meteorological conditions, the information available is not so full as might be desired, but it is sufficient to show that the site chosen compares favorably with any other which has

been suggested in India. At one time Simla was proposed as a suitable place for an observatory, and at certain seasons of the year probably no better site could be found. At other seasons, however, the air is so full of dust rising from the heated plains that no observations of any value could be made. When the question of selecting a site for the observatory came up some three years ago, it was agreed that the choice practically lay between the Nilgiris and the Palanis. The best place on each was chosen (Kotagiri and Kodaikanal), and meteorological observations were carried on at each for a year. A discussion of the results by Mr. J. ELIOT, Meteorological Reporter to the Government of India, and myself showed clearly that Kodaikanal was to be preferred. A few of the actual statistics collected for Kodaikanal may be of interest:

The mean daily temperature varied from $54^{\circ}.1$ F. in December to $62^{\circ}.2$ in May; the mean for the year was $58^{\circ}.5$. The mean daily range varied from $11^{\circ}.5$ F. in August to $16^{\circ}.8$ in February.

The mean humidity varied from 47 per cent. in March to 83 per cent. in August; the mean for the year being 72 per cent. The actual number of days on which 0.01 inch of rain, and upwards, fell was 155, distributed through the 12 months thus: 4, 5, 3, 16, 19, 19, 21, 24, 8, 21, 7, 8. The total rainfall was 47.53 inches; but the average over a number of years for a station a mile and a half distant, and nearer the edge of the cliffs, is 61 inches.

There were 2056 hours of bright sunshine throughout the year, and a careful analysis of the records shows that the mornings and forenoons are usually clear, the afternoons frequently cloudy; but the clouds tend to clear away again before sunset. Of the state of the sky during the night, there is not much trustworthy information; but my own experience during a number of short visits is that a night which remains cloudy throughout is very rare, and that a large proportion of the nights are brilliantly clear. On the whole, the climate is a magnificent one, combining many of the advantages of tropical and temperate regions.

On two occasions I have made a series of astronomical observations at Kodaikanal—once in June and the other time in February,—and both times with the most favorable results. On the second occasion the observations were designed to com-

pare the relative merits of Madras, Kodaikanal, and Kotagiri for astronomical work, and the result left no doubt that Kodaikanal was far superior in every respect. It is not necessary here to go into details; but I may say that, as regards solar observations, both telescopic and spectroscopic, excellent definition could be obtained up to from 10:30 to 11 A.M., almost every day, and on several days good observations were also made in the afternoons. As regards night work, the most striking features were the wonderful brightness of nebulae, and the sharpness of the images of the planets, even under high magnifying powers. In observing *Saturn*, for instance, even far from the zenith, a power of 360 could be used with advantage on a telescope of 3.7 inches aperture. In observing stellar spectra the clearness of the lines and the absence of "flickering" were very striking features to one who had made most of his observations from near the sea-level. Many other tests were made, but the advantages of high-level over low-level observatories are now so fully admitted that it is needless to detail them.

At first it is the intention that the work in the new observatory shall be mainly directed towards solar physics, and the proposed equipment consists chiefly of instruments already in India. These are two photoheliographs of the KEW pattern, with 4-inch and 6½-inch objectives, giving solar pictures of 8 inches and 12 inches diameter, at present at Dehra Dūn; a 6-inch COOKE equatorial, with a powerful, but somewhat obsolete, form of prism spectroscope for solar work, and the necessary minor instruments. In addition to these, there will probably be a 6-inch photographic lens of 36 inches focal length, mounted with the LEREBOURS and SECRETAN equatorial of the Madras Observatory as a finder, a small spectroscope, with a ROWLAND grating fitted for photography, and the zodiacal light spectrograph made for me by HILGER some years ago. Later, I hope that a large equatorial will be added, but for that we may have to wait for some time.

In addition to astronomical work proper, it is proposed to carry on actinometric and meteorological observations, and, in connection with the latter, it is probable that a low-level meteorological station will be started on the plains, some 6500 feet below, and at a horizontal distance of only 4 or 5 miles. The final designs for the buildings have not yet been prepared, but the observatory will probably be built in the form of a cross,

of which the longer arms will lie east and west, with an equatorial dome at the east, and a transit-room at the west extremity. The north and south arms will also terminate in domes for one of the photoheliographs and the photographic equatorial. For the spectroscopic work, probably, a heliostat will be used in connection with a fixed telescope, the axis of which is pointed to the pole. The astronomer's house is to be built a little below the observatory, so as to be sheltered from the strong winds on the hilltop, but will be close at hand, while houses for two or three assistants will be built somewhat farther off.

The staff as at present proposed will consist of the director,—who will also have charge of the Madras Observatory,—three assistants, a clerk, a mechanic, and the necessary servants. The headquarters of the director will be at Kodaikanal, and there will be an assistant superintendent and two assistants at Madras to carry on the time service and the meteorological observations. Two other assistants, whose main work will be computing, will probably be stationed at Madras so long as the publication of the arrears of old observations is going on.

MADRAS OBSERVATORY, 19th February, 1895.

LATEST NEWS FROM MARS.

[From the Boston *Commonwealth*.]

By EDWARD E. HALE.

“Mr. LOWELL's four lectures on the planet *Mars* were heard by crowded audiences of people who filled every seat and all the standing-room in Huntington Hall. For once, we got the very latest advices from that planet. The observatory in Flagstaff, as our readers know, was established by Mr. LOWELL himself, and the position of *Mars* in the last summer gave him opportunity to make such observations as have never been made before, and to reveal to us what are marvels indeed. The result, as our readers know, is the firm conviction in his mind that intelligent beings occupy the planet *Mars*, who know how to work in the common good, who have contrived public works of vastly larger extent than we of the Earth have dreamed of, and have carried out their